CLAIMS

1. An ultrasonic diagnostic apparatus comprising:

an ultrasonic probe driving section for driving an ultrasonic probe for transmitting an ultrasonic transmission wave to an object to be measured including a fluid portion in which fluid moves,

a receiving section for amplifying an ultrasonic reflected wave obtained when the ultrasonic transmission wave reflects from the object to be measured and received by the ultrasonic probe;

a phase detecting section for phase-detecting the ultrasonic reflected wave;

a computing section for obtaining the velocities of the object to be measured at a plurality of measuring positions of the object to be measured from the phase-detected signal and obtaining the deformation amounts and/or elastic moduli between measuring positions of the object to be measured from the velocities;

a fluid determining section for determining a fluid portion in the object to be measured in accordance with the phase-detected signal; and

an image data generating section for generating image data for two-dimensionally image-displaying the deformation amounts and/or elastic moduli of the object to be measured in a region other than the fluid portion by using the information determined by the fluid determining section.

2. The ultrasonic diagnostic apparatus according to claim 1, wherein the fluid determining section determines the fluid portion by the Doppler method.

3. The ultrasonic diagnostic apparatus according to claim 2, further comprising:

a filter section for dividing the phase-detected signal into a frequency component higher than a predetermined value and a frequency component equal to or lower than the predetermined value and selectively inputting signals of the divided frequency components to the fluid determining section and the computing section.

4. The ultrasonic diagnostic apparatus according to claim 2, wherein:

the ultrasonic probe driving section generates a first driving pulse suited to obtain the deformation amounts and/or elastic moduli of the object to be measured and a second driving pulse suited to determine a fluid portion by the Doppler method,

the computing section obtains the deformation amounts and/or elastic moduli in accordance with a signal obtained by phase-detecting an ultrasonic reflected wave obtained by the first driving pulse, and

the fluid determining section determines the fluid portion in accordance with a signal obtained by phase-

detecting an ultrasonic reflected wave obtained by the second driving pulse.

5. The ultrasonic diagnostic apparatus according to any one of claims 1, 2, and 4, wherein the image data generating section generates image data obtained by synthesizing a first image obtained by using gradation display or chroma display corresponding to the deformation amounts and/or elastic moduli between the measuring positions and thereby two-dimensionally mapping the deformation amounts and/or elastic moduli and a second image obtained by displaying the fluid portion with a predetermined color and displaying a region other than the fluid portion with colorless transparence.

6. The ultrasonic diagnostic apparatus according to any one of claims 1, 2, and 4, wherein the image data generating section generates image data including a third image obtained by showing the deformation amounts and/or elastic moduli at positions corresponding to the fluid portion with a predetermined color or colorless transparence and two-dimensionally mapping the deformation amounts and/or elastic moduli at positions corresponding to a region other than the fluid portion by gradation display or chroma display corresponding to the deformation amounts and/or elastic moduli.

7. The ultrasonic diagnostic apparatus according to claim 5 or 6, further comprising:

an envelop detecting section for envelop-detecting the ultrasonic reflected wave and an amplifying section for logarithm-amplifying an envelop-detected signal, wherein the image data generating section generates image data obtained by synthesizing a B-mode image generated in accordance with a signal obtained from the amplifying section with the first and second images or the third image.

8. The ultrasonic diagnostic apparatus according to claim 7, wherein:

the ultrasonic probe driving section further generates a third driving pulse suited to generate a B-mode image, and

the envelop detecting section envelop-detects an ultrasonic reflected wave obtained from the third driving pulse.

9. The ultrasonic diagnostic apparatus according to any one of claims 1 to 8, further comprising a display section for displaying an image in accordance with image data output from the image data generating section.

10. A control method of an ultrasonic diagnostic apparatus having a transmitting/receiving section for transmitting/receiving an ultrasonic wave, a phase-

detecting section for phase-detecting the received ultrasonic wave, and a computing section for computing a deformation amount and/or elastic module in accordance with the phase-detected ultrasonic wave, comprising the steps of:

(A) transmitting an ultrasonic wave to an object to be measured including a fluid portion in which fluid moves and receiving an ultrasonic reflected wave obtained when the ultrasonic wave reflects from the object to be measured;

(B) phase-detecting the ultrasonic reflected wave;

(C) obtaining the velocities of the object to be measured at a plurality of measuring positions of the object to be measured in accordance with the phase-detected signal and obtaining the deformation amounts and/or elastic moduli between the measuring positions of the object to be measured from the velocities;

(D) determining a fluid portion in the object to be measured in accordance with the phase-detected signal; and

(E) using information determined by the fluid determining section and thereby generating image data for two-dimensionally image-displaying the deformation amount an/or elastic module of the object to be measured in a region other than the fluid portion.

11. The ultrasonic diagnostic apparatus control method according to claim 10, wherein the fluid portion is

determined in the step (D) in accordance with the Doppler method.

12. The ultrasonic diagnostic apparatus control method according to claim 11, further comprising:

a step (F) of separating a frequency component higher than a predetermined value and a frequency component equal to or lower than the predetermined value from the phase-detected signal, wherein the step (C) is executed in accordance with signals of the separated frequency components.

13. The ultrasonic diagnostic apparatus control method according to claim 11, wherein:

a first driving pulse suited to obtain the deformation amounts and/or elastic moduli of the object to be measured and a second driving pulse suited to determine a fluid portion in accordance with the Doppler method are transmitted to the object to be measured in the step (A),

the deformation amounts and/or elastic moduli are or is obtained from a signal obtained by phase-detecting an ultrasonic reflected wave obtained from the first driving pulse in the step (C), and

the fluid portion is determined from a signal obtained by phase-detecting an ultrasonic reflected wave obtained from the second driving pulse in the step (D).

14. The ultrasonic diagnostic apparatus control method according to any one of claims 10, 11, and 13, wherein: the step (E) generates image data obtained by synthesizing a first image obtained by using gradation display or chroma display corresponding to the deformation amounts and/or elastic moduli and thereby two-dimensionally mapping the deformation amounts and/or elastic moduli with a second image obtained by displaying the fluid portion with a predetermined color and displaying a region other than the fluid portion with colorless transparence.

15. The ultrasonic diagnostic apparatus control method according to any one of claims 10, 11, and 13, wherein the step (E) generates image data obtained by displaying the deformation amounts and/or elastic moduli at positions corresponding to the fluid portion with a predetermined color or colorless transparence and using gradation display or chroma display corresponding to the deformation amounts and/or elastic moduli at positions corresponding to a region other than the fluid portion and thereby two-dimensionally mapping the deformation amounts and/or elastic moduli.

16. The ultrasonic diagnostic apparatus control method according to claim 14 or 15, further comprising a step (G) of envelop-detecting the ultrasonic reflected wave and logarithm-amplifying an envelop-detected signal,

wherein the step (E) generates image data obtained by synthesizing a B-mode image according to the logarithm-amplified signal with the first and second images or the third image.

17. The ultrasonic diagnostic apparatus control method according to claim 16, wherein:

a third driving pulse suited to generate a B-mode image is further generated in the step (A), and

an ultrasonic reflected wave obtained from the third driving pulse is envelop-detected in the step (G).